Claims

1. A method of holographically storing data as in a series of grating structures including m-level coded elements in an optical data carrier, wherein $m \geq 2$, the method comprising:

forming a grating sampling function as a direct sum of N partial grating sampling functions, each partial grating sampling function having a phase (φ_n) and amplitude (d_n), wherein each d_n has m possible values.

2. A method as claimed in claim 1, wherein the method further comprises:

conducting an optimisation process to determine a set of phases φ_n for which a required maximum refractive index variation in the optical data carrier is related to N^x, where $0.5 \leq x \leq 1$.

3. A method as claimed claim 2 wherein the required maximum refractive index variation in the optical data carrier is proportional to N^x

4. A method as claimed in either claim 3 or 4 wherein $x \approx 0.5$.

5. A method as claimed in claim any one of the preceding claims, wherein the step of forming a grating sampling function comprises:

forming the sampling function as a direct sum of L groups of N partial grating sampling functions, each $L \times N$ partial grating sampling functions having phases and amplitudes, represented by matrices φ_{nl}, d_{nl}, respectively;

and wherein the step conducting the optimisation process comprises:

separating the matrix φ_{nl} into sets of N phases corresponding to the N partial grating sampling functions in a given group, and one set of L phases between the L groups;

determining the sets of phases for each group of N partial grating sampling functions from a database having stored therein possible combinations of N coded data elements and associated sets of phases; and

conducting said optimisation process to determine the set of L phases between the L.

6. A method as claimed in claim 5, wherein the optimisation process to determine the set of L phases between the L groups comprises conducting the optimisation process to

determine the set of L phases between the L groups for which a functional characteristic of the sampling function is minimised.

7 A method as claimed in claim 6, wherein the functional characteristic of the sampling function being minimised is a mean-square deviation or maximum amplitude.

8. A method as claimed in claims 6 or 7, wherein, the optimisation process to determine the set of L phases between the L groups, comprises applying a functional analysis to determine the set of L phases between the L groups for which a functional characteristic of the sampling function is minimised.

9. A method as claimed in claim 8, wherein the functional analysis comprises a steepest descent (gradient) method.

10. A method as claimed in claims 8 or 8, wherein the optimisation process to determine the set of L phases between the L groups comprises approximating the functional characteristic of the sampling function utilising an aperiodic autocorrelation function.

11. A method as claimed in claim 10, wherein the optimisation process to determine the set of L phases between the L groups further comprises, deriving a gradient of the functional of the sampling function from a derivative of the aperiodic autocorrelation function.

12. A method as claimed any one of the preceding claims, wherein the partial grating sampling functions comprise one- or multi-dimensional functions.

13. An optical data carrier configured to store data in a plurality of grating structures, said optical data carrier having at least one data reading face through which the grating structures are optically accessible for reading, wherein each grating structure comprises a series of m-level coded elements, where $m \geq 2$, for storage of data.

14. An optical data carrier as claimed in claim 13, wherein a required maximum refractive index variation in the optical data carrier is related to N^x and wherein $0.5 \leq x \leq 1$ and N denotes a number of partial grating sampling functions from which the grating structure is formed.

15. An optical data carrier as claimed in claim 13 or 14 wherein the required maximum refractive index variation in the optical data carrier is proportional to N^x and $0.5 \leq x \leq 1$.

16. An optical data carrier as claimed in any one of claims claim 13 or 14 wherein $x \approx 0.5$.

17. An optical data carrier as claimed any one of claims 13 to 16, wherein the optical data carrier is disk-shaped.

18. An optical data carrier as claimed any one of claims 13 to 17, wherein the grating structures comprise one- or multi-dimensional grating structures.

19. An optical data carrier as claimed any one of claims 13 to 18, wherein the optical data carrier comprises a rolled-up material strip in which the plurality of grating structures are formed.

20. An optical data carrier as claimed any one of claims 13 to 19, further comprising means for maintaining the material strip in a rolled-up state.

21. An optical data carrier as claimed any one of claims 13 to 20, wherein the means for maintaining the material strip in a rolled-up state comprises a curable material.

22. An optical data carrier as claimed any one of claims 13 to 21, wherein the means for maintaining the material strip in a rolled-up state comprises a mechanical structure.

23. A method of storing data in an optical data carrier, the method comprising the steps of:

storing the data in a material strip, and

arranging the material strip to form the optical data carrier having a reading face from which the stored data is optically accessible to enable reading the stored data.

24. A method as claimed in claim 23, wherein arranging the material strip to form the data carrier comprises spooling the material strip into a disk-shaped optical data carrier.

25. A method as claimed in claims 23 or 24, wherein the material strip comprises a photosensitive material strip, and the step of storing the data comprises inducing refractive index changes in the photosensitive material strip to form grating structures that holographically store the data, wherein a required maximum refractive index variation in the grating structures of the optical data carrier is related to N^x and wherein $0.5 \le x \le 1$.

26. An optical data carrier comprising a material strip arranged in a manner such that data stored in the material strip is optically accessible from a reading face to enable reading of the data stored on the optical data carrier.

27. An optical data carrier as claimed in claim 26, wherein the optical data carrier is formed by spooling the material strip into a disk.

28. An optical data carrier as claimed in claims 26 or 27, wherein the material strip comprises a plurality of grating structures containing the optical data, and wherein each grating structure is optically accessible from the reading face.

29. An optical data carrier as claimed in any one of claims 26 to 28, further comprising means for releasably maintaining the material strip in the disk shape.

30. A method of forming a disk configured to store data in a plurality of optical data structures including:

providing a strip-like data carrier for storing the plurality of optical data structures; and

winding the strip-like data carrier into a disk.

31. The method of claim 30 wherein the step of providing the strip-like data carrier includes writing the plurality of optical data structures into a strip-like carrier substrate.

32. The method of either of claims 30 or 31 wherein the optical data structures are grating structures having m-level coded elements where $m \geq 2$.

33. The method of any one of claims 30 to 31 further including attaching adjacent layers of the strip-like data carrier to each other in the wound disk.